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IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

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Group Art Unit: **2643**
Examiner: **Lao**
Attorney Docket No.: **Chen 3-1**
Our Ref.: **73-852**

IN RE PATENT APPLICATION OF:

CHEN

TITLE: **METHOD AND APPARATUS FOR PROCESSING INTERAURAL TIME DELAY IN 3D DIGITAL AUDIO**

July 9, 2003

APPEAL BRIEF

Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Sir:

The Applicant submits herewith the following Appeal Brief in triplicate as required by 37 C.F.R. § 1.192.

(1) REAL PARTY IN INTEREST

The real party in interest is Agere Systems Inc.

(2) RELATED APPEALS AND INTERFERENCES

The Applicant and his legal representatives and assignee are not aware of any other appeals or interferences that will directly affect or be directly affected by or have a bearing on the Board's decision in the appending appeal.

(3) STATUS OF THE CLAIMS

Claims 1-14 are pending in this application. Claims 1-14 stand rejected.

(4) STATUS OF ANY AMENDMENT FILED SUBSEQUENT TO FINAL REJECTION

The Applicant has not filed any amendment after final rejection.

(5) SUMMARY OF THE INVENTION

Conventional 3D sound systems embed an interaural time difference in empirically determined head-related transfer functions (HRTFs), typically determined with a mannequin head implanted with microphones in its ears. The available delays typically have a relatively large resolution, e.g., 100 microseconds, formed by null filter taps. A large resolution in available time delays causes discretely sampled interaural time differences for an expected position of a listener. Thus, a 'closest' or 'best fit' interaural time delay (ITD) must be chosen, which may be up to 50% away from the ideal parameter. This may cause a jittering effect in the sense of movement of the sound by the listener.

Conventionally, proposed implementations provide a more accurate ITD based on a given resolution by interpolating an entire HRTF set such that the ITD becomes interpolated as well. Unfortunately, interpolation itself can become a computationally intense requirement which likely adds to, rather than cures, the computational inefficiency otherwise associated with digital 3D sound systems.

The present invention is directed to an apparatus and method for efficiently providing and simplifying the creation of 3D sound. In particular, two delays in series are added together to create a 3D perceived positional sound.

(6) CONCISE STATEMENT OF THE ISSUES PRESENTED FOR REVIEW

(A) Whether claims 1-14 are obvious under 35 U.S.C. §103(a) over Nagata et al., U.S. Patent No. 5,974,154 ("Nagata") in view of Matsumoto et al., U.S. Patent No. 5,381,482 ("Matsumoto").

(7) WHETHER THE CLAIMS STAND OR FALL TOGETHER

Group I: Claims 1 and 6 stand or fall together because each includes the following distinctive features:

(1) a first delay module providing a choice of delay within a first resolution for use in a 3D audio sound system; and

(2) a second delay module in series with the first delay module, the second delay module providing a choice of a plurality of additional fractional delays, each of the additional fractional delays being less than a first resolution;

(3) wherein the first resolution is added to the additional fractional delays for use in the 3D audio sound system to create a perceived positional sound.

Group II: Claim 2 stands or falls together because it includes the following distinctive feature:

(1) a first-in, first out buffer.

Group III: Claim 3 stands or falls together because it includes the following distinctive feature:

(1) a choice of any one of a plurality of polyphase filters, each of the polyphase filters providing an additional fraction delay less than a first resolution.

Group IV: Claims 4 and 5 stand or fall together because each includes the following distinctive feature:

(1) a localization control module comprising an interaural time delay look-up table associating desired sound source locations with a particular interaural time delay.

Group VI: Claims 7-9 and 11-13 stand or fall together because each includes the following distinctive features:

(1) selecting one of a plurality of available first time delays having a first resolution between each of the plurality of available first time delays;

(2) selecting one of a plurality of available second time delays, each of the plurality of available second time delays being less than the first resolution; and

(3) adding the selected first time delay and the second time delay to provide a desired interaural time delay for use in a digital 3D sound system to create a perceived positional sound.

Group V: Claims 10 and 14 stand or fall together because each includes the following distinctive features:

(1) fixing a first interaural time delay with respect to a first ear of a listener; and

(2) providing a desired interaural time delay with respect to a second ear of the listener.

(8) ARGUMENTS WITH RESPECT TO THE ISSUES PRESENTED FOR REVIEW

(A) Claims 1-14 are not obvious under 35 U.S.C. § 103(a) over Nagata in view of Matsumoto.

Rejected claims 1 and 6 require adding a choice and selecting one of a plurality of a first delay and a second delay module in series with the first delay module, the second delay module providing a choice of a plurality of additional fractional delays, each of the additional fractional delays being less than a first resolution, wherein the first resolution is added to the additional fractional delays for use in the 3D audio sound system to create a perceived positional sound. Rejected claims 7-9 and 11-13 require selecting one of a plurality of available first time delays having a first resolution between each of the plurality of available first time delays, selecting one of a plurality of available

second time delays, each of the plurality of available second time delays being less than the first resolution and adding the selected first time delay and the second time delay to provide a desired interaural time delay for use in a digital 3D sound system to create a perceived positional sound.

The Examiner alleged that since Nagata discloses use of a combination of FL, FR, RL and RR signals, Nagata discloses a 3D audio system. The Applicant respectfully disagrees.

Nagata's system employing four speakers to produce sound does not make 3D audio sound. Nagata does have four speakers with echo cancellation, but does NOT have 3D audio sound. Nagata utilizes a simplistic approach to adding depth to sound, i.e., adding echo. The Applicant is creating a perceived **positional** sound. Adding echo to a sound source does not allow a listener to perceive the sound's **position** at any particular location. The Applicant's invention allows a listener to listen to a sound that creates the perception of a 3D audio effect, which is created by a **choice** of delays. The recited **choice** of delay is what controls the **perceived position** of the sound to a listener. Nagata's echo effect can not achieve such a sophisticated result.

Moreover, the Examiner alleged that Matsumoto is not relied on to disclose selecting or a choice of delays, but is relied on to teach that the magnitude of an additional/second delay is a fraction of that of a first delay produced by a preceding/first delay module. The Examiner correctly acknowledged, Matsumoto discloses a first fixed delay (20ms) added to a second fixed delay (0.7ms). **Fixed** delays would at best allow sound to be perceived at a **fixed** location.

At best, even if the theoretical combination of Nagata and Matsumoto were combinable (which they are not), the combination would produce an echo generation system that would have a second echo delay unit having a fractional magnitude of a echo first delay. The delay values would still produce an echo effect, **NOT** a perceived **positional** sound. The echo effect produced would then not be as great with the second delay now being smaller that Nagata originally intended. Thus, the theoretical combination would produce

an echo effect possibly not even meeting the needs of a karaoke system as envisioned by Nagata.

Neither Nagata nor Matsumoto, either alone or in combination, disclose, teach or suggest a first delay module providing a **choice** of delay within a first resolution for use in a **3D audio sound system**, and a second delay module in series with the first delay module, the second delay module providing a **choice** of a plurality of additional fractional delays, each of the additional fractional delays being less than a first resolution, wherein the first resolution is added to the additional fractional delays for use in the 3D audio sound system to create a **perceived positional sound**, as recited by claims 1 and 6.

Moreover, neither Nagata nor Matsumoto, either alone or in combination, disclose, teach or suggest **selecting** one of a plurality of available first time delays having a first resolution between each of the plurality of available first time delays, **selecting** one of a plurality of available second time delays, each of the plurality of available second time delays being less than the first resolution and adding the selected first time delay and the second time delay to provide a desired interaural time delay for use in a **digital 3D sound system** to create a **perceived positional sound**, as recited by claims 7-9 and 11-13.

Rejected claim 2 requires a first-in, first out (FIFO) buffer.

Neither Nagata nor Matsumoto disclose use of a FIFO buffer for any purpose, much less as a delay module in a 3D audio sound system. The Examiner has failed to provide a single reference that discloses or suggests using a FIFO buffer in a 3D audio sound system to create a perceived **positional** sound, as recited by claim 2.

Rejected claim 3 requires a choice of any one of a plurality of polyphase filters, each of the polyphase filters providing an additional fraction delay less than a first resolution.

The Examiner alleged that Nagata's item 921 in Fig. 8 is a polyphase filter. The Applicants respectfully point out item 921 in Fig. 8 is disclosed to be an equalizer. An equalizer, performs equalization functions, is NOT a polyphase filter. Neither Nagata nor Matsumoto, either alone or in

combination, disclose, teach or suggest use of a polyphase filter, much less a plurality of polyphase filters for providing an additional **fraction** delay in a 3D audio system, as recited by claim 3.

Rejected claims 4 and 5 require a localization control module comprising an interaural time delay look-up table associating desired sound source locations with a particular interaural time delay.

The Examiner alleged that Nagata discloses an interaural time delay look-up table at col. 6, lines 7-42. The Applicants respectfully point out Nagata discloses a table that stores values of various gain values and a selection order of delay terminals. A table storing a selection order of delay terminals is **NOT** storing delay values themselves, much less constitute an interaural time delay look-up table. Neither Nagata nor Matsumoto, either alone or in combination, disclose, teach or suggest use of a interaural time delay look-up table, much less a localization control module comprising an interaural time delay look-up table associating desired sound source locations with a particular interaural time delay, as recited by claims 4 and 5.

Claims 10 and 14 require **fixing** a first interaural time delay with respect to a first ear of a listener and providing a **desired** interaural time delay with respect to a second ear of the listener.

Nagata discloses a plurality of available time delays for use in creating echo, the available time delays being predetermined delays to create a specified amount of echo. Various delay values are used for both a left and right channel to create the echo effect. Nagata fails to disclose or suggest **fixing** a first interaural time delay with respect to a first ear of a listener, much less **fixing** a first interaural time delay with respect to a first ear of a listener and providing a **desired** interaural time delay with respect to a second ear of the listener, as recited by claims 10 and 14.

Matsumoto discloses applying a fixed delay to a both a left and right channel. Matsumoto fails to disclose or suggest **fixing** a first interaural time delay with respect to a first ear of a listener and providing a **desired** interaural

time delay with respect to a second ear of the listener, as recited by claims 10 and 14.

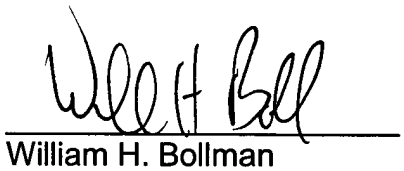
Neither Nagata nor Matsumoto, either alone or in combination, disclose, teach or suggest **fixing** a first interaural time delay with respect to a first ear of a listener and providing a **desired** interaural time delay with respect to a second ear of the listener, as recited by claims 10 and 14.

It is respectfully submitted that not only does this rejection fail on its face, and thus is improper, but also in light of the above comments its clear that Nagata in view of Matsumoto does not make obvious any of claims 1-14. Thus, the rejection of claims 1-14 under 35 U.S.C. § 103(a) is improper and should be reversed.

CONCLUSION

For all the reasons set forth above, the rejections of claims 1-14 are improper and should be reversed. The Applicants therefore respectfully request that this Appeal be granted and that the rejections of the claims be reversed.

Respectfully submitted,



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APPENDIX

CLAIMS INVOLVED IN THE APPEAL

1. A digital delay line for use in a 3D audio sound system, comprising:

a first delay module providing a choice of delay within a first resolution for use in said 3D audio sound system; and

a second delay module in series with said first delay module, said second delay module providing a choice of a plurality of additional fractional delays, each of said additional fractional delays being less than said first resolution;

wherein said first resolution is added to said additional fractional delays for use in said 3D audio sound system to create a perceived positional sound.

2. The digital delay line for use in a 3D audio sound system according to claim 1, wherein said first delay module comprises:

a first-in, first out buffer.

3. The digital delay line for use in a 3D audio sound system according to claim 1, wherein said second delay module comprises:

a choice of any one of a plurality of polyphase filters, each of said polyphase filters providing an additional fraction delay less than said first resolution.

4. The digital delay line for use in a 3D audio sound system according to claim 1, further comprising:

a localization control module comprising an interaural time delay look-up table associating desired sound source locations with a particular interaural time delay.

5. The digital delay line for use in a 3D audio sound system according to claim 4, wherein said localization control module further comprises:

an integer and fractional delay selector adapted to determine a first time delay for use by said first delay module and said additional fractional delay for use by said second delay module.

6. The digital delay line for use in a 3D audio sound system according to claim 1, wherein:

said first resolution is based on a sampling rate of a digital audio signal.

7. A method for providing an interaural time delay in a digital 3D sound system, comprising:

selecting one of a plurality of available first time delays having a first resolution between each of said plurality of available first time delays;

additionally selecting one of a plurality of available second time delays, each of said plurality of available second time delays being less than said first resolution; and

adding said selected first time delay and said second time delay to provide a desired interaural time delay for use in said digital 3D sound system to create a perceived positional sound.

8. The method for providing an interaural time delay in a digital 3D sound system according to claim 7, wherein:

said desired interaural time delay relates to a desired interaural time delay for one ear of a listener; and

said first time delay relates to a desired interaural time delay for a second ear of said listener.

9. The method for providing an interaural time delay in a digital 3D sound system according to claim 7, wherein:

said plurality of available time delays are based on a sampling rate of a digital audio signal.

10. The method for providing an interaural time delay in a digital 3D sound system according to claim 7, further comprising:

fixing a first interaural time delay with respect to a first ear of a listener; and

providing said desired interaural time delay with respect to a second ear of said listener.

11. Apparatus for providing an interaural time delay in a digital 3D sound system, comprising:

means for selecting one of a plurality of available first time delays having a first resolution between each of said plurality of available first time delays;

means for additionally selecting one of a plurality of available second time delays, each of said plurality of available second time delays being less than said first resolution; and

means for adding said selected first time delay and said second time delay to provide a desired interaural time delay for use in said digital 3D sound system to create a perceived positional sound.

12. The apparatus for providing an interaural time delay in a digital 3D sound system according to claim 11, wherein:

said desired interaural time delay relates to a desired interaural time delay for one ear of a listener; and

said first time delay relates to a desired interaural time delay for a second ear of said listener.

13. The apparatus for providing an interaural time delay in a digital 3D sound system according to claim 11, wherein:

said plurality of available time delays are based on a sampling rate of a digital audio signal.

14. The apparatus for providing an interaural time delay in a digital 3D sound system according to claim 11, further comprising:

means for fixing a first interaural time delay with respect to a first ear of a listener; and

means for providing said desired interaural time delay with respect to a second ear of said listener.